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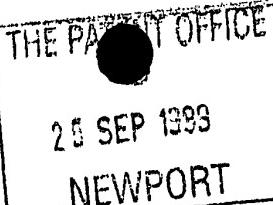
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27SEP99 E479434-2 D02605  
F017700 0.00-9922682.1

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The Patent Office

Cardiff Road  
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1. Your reference

P915

27SEP99 E479434-2 D02605  
F017700 0.00-9922682.1

2. Patent application number

(The Patent Office will fill in this part)

**9922682.1**

3. Full name, address and postcode of the or of each applicant (underline all surnames)

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Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

**MIXING APPARATUS AND METHOD**

5. Name of your agent (if you have one)

CRASICE & CO  
PATENT LAW CHAMBERS  
15 QUEENS TERRACE  
EXETER  
EX4 4HT

Patents ADP number (if you know it)

79 41 004 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

→

- any applicant named in part 3 is not an inventor, or
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Description *9*

Claim(s)

Abstract

Drawing(s) *3+3* *R*

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Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination  
(*Patents Form 10/77*)

Any other documents  
(please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature *Ceville G.*

Date *24-09-99*

12. Name and daytime telephone number of person to contact in the United Kingdom

*Mr DR CRASKE 01392 413 479*

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Christopher Roy Rogers

Richard Tipton Smith

## MIXING APPARATUS AND METHOD

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### TECHNICAL FIELD OF THE INVENTION

This invention relates to the mixing of liquid and semi-liquid materials.

### BACKGROUND

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Conventional mixers have rotating shafts or moving blades that break the surface and entrain air into the mix. There are many cases where entrained air bubbles in the mix are most undesirable, for example coatings or lacquers that are spread very thinly, or mixes that are to be cast where bubbles are left in the solidified product either weakening it or making it scrap. Conventional mixers also have to be cleaned between mixes, which takes time, risks cross-contamination and often creates a problem in disposing of the waste materials.

The present invention seeks to provide a new and inventive mixing technique and apparatus.

## SUMMARY OF THE INVENTION

The present invention proposes mixing apparatus comprising a container for material to be mixed, said container having a bottom wall and being provided with a plunger wall which is movable relative to said bottom wall to squeeze said material therebetween and which surrounds at least one opening in a central region of the plunger wall through which said material can pass.

The apparatus thus produces a mixing action in liquids by generating a radial pumping effect within a container.

The plunger wall preferably contains a single central opening to minimise air entrainment. The lower surface of the plunger wall surrounding the opening is preferably of a substantially uniform width and is preferably substantially planar. The maximum dimension of the opening is preferably greater than 20% of the maximum dimension of the plunger wall, preferably greater than 30 % and ideally greater than 40%, depending on the nature of the materials being mixed.

In some forms of the apparatus the plunger wall may be provided by a separate plunger which is movable within the container. The plunger wall may also be formed integral with the container if the portion of the container between the plunger wall and the bottom wall is flexible, e.g. radially expandable or axially compressible.

The invention further provides a method of mixing comprising placing material to be mixed into a container having a bottom wall, and reciprocally

moving a plunger wall relative to said bottom wall to squeeze said material therebetween, said plunger wall surrounding an opening in a central region of the plunger wall through which said material may pass.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The following description and the accompanying drawings referred to therein are included by way of non-limiting example in order to illustrate how the invention may be put into practice. In the drawings:

Figure 1 is a vertical section through a first form of mixing apparatus in accordance with the invention;

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Figure 2 is a plan view of the apparatus shown in Fig. 1;

Figure 3 is a vertical section through a second form of the mixing apparatus; and

Figure 4 is a vertical section through a third form of the mixing apparatus.

#### DETAILED DESCRIPTION OF THE DRAWINGS

Referring firstly to Fig.s 1 and 2, the mixing apparatus comprises a container 1 and a plunger 2, both of which may conveniently be moulded of plastics. The container 1 has a circular bottom wall 10, and an upstanding cylindrical

side wall 11 surmounted by an inwardly-extending annular flange 12. The plunger 2 has a solid annular head 20 which surrounds a single circular opening 21 in the central region of the plunger. A cylindrical shank 22 is upstanding from the head 20 to slide within the flange 12. The upper end of the shank 22 is bridged by a handle 23. Four circumferentially equally-spaced fins 24 project radially from the shank 22, joined to the head 20. The fins guide the plunger within the side wall of the container 1, passing through corresponding notches 13 in the flange 12. When the head 20 is located adjacent to the bottom wall of the container 1 the shank 22 can be rotated allowing the fins to pass beneath the flange 12 which thereby hold the plunger in position.

Taking mixing wallpaper paste as a specific example, the apparatus can be lined by a flexible plastics bag 3. It has been found that the type of bag described as having a star sealed bottom is particularly suitable. The bag is placed into the lower part of the container 1 beneath the plunger 2. The bag is fed through the central opening 21 to line the inside of the shank 22, with the mouth of the bag being secured to internal attachment formations 26 on opposite sides of the shank 22. The bag could be attached to the shank in many ways. A simple way is to fold it back over the top of the shank and put an elastic band around it. Another way would be to use a bag with handles and use these to attach it.

The bag is filled with the required volume of water and a measured amount of paste granules are sprinkled onto the surface of the water. The handle is then gripped and the plunger is moved up and down ensuring that the stroke of the plunger head 20 is below the surface of the water. Liquid in the portion of the bag below the plunger is forced radially inwards. Depending

upon the speed of movement of the plunger, the depth of liquid and the diameter of the opening, a jet of water may emerge centrally from the surface of the liquid, or it may cause an agitated plug of liquid to arrive at the surface. There is a noticeable delay between the plunger starting to move downwards and the disturbance arriving at the surface. In all cases the liquid is agitated. When the plunger is raised on its return stroke the liquid flows back through the opening. The primary flow back appears to be around the periphery of the liquid. Repeated lowering and raising of the plunger generates a good mixing action. Liquid is displaced radially producing a centralised vertical flow and is drawn down the outside into the region below the plunger giving a toroidal flow pattern. The agitation within the vertical flow and at the surface is dependent upon the proportions of the apparatus and on the speed, timing, and frequency of the plunger movement. Experiments have shown that if a colourant is placed near the outside region of a quantity of water in the bag three or four cycles will completely disperse it. When the wallpaper paste is sprinkled on the top of the water three or four strokes will mix it in efficiently. As the paste thickens the effectiveness of the radial pumping is reduced eventually leaving an undisturbed central portion. A smaller diameter opening may improve the mixing of thick pasty materials.

When mixing is complete the plunger 2 can be pushed down until the fins 24 engage under the flange 12 to lock the plunger leaving virtually all the paste accessible within the shank portion 22.

When the paste has been used the bag is thrown away and the mixer is left clean and ready for reuse.

It will be appreciated that the bag need not necessarily be used, although the apparatus must be washed thoroughly to remove the paste after use. The bag could also be used to line the container with the plunger placed within the bag, although obviously the plunger will require cleaning in such cases. This should be done immediately on completing the mixing, when the paste will wash off easily. Very thin and inexpensive bags can be used since it is fully supported within the apparatus.

The motion of the plunger can be made more complex, e.g. incorporating rocking or circular motion into the basic reciprocating movement.

It will be appreciated that the container 1 could, in a simple form of the apparatus, be a conventional bucket provided with a loose-fitting plunger 2, optionally supplied with one or more bags. Such apparatus can be used very effectively for mixing pastes.

Fig. 3 shows a form of the mixing apparatus which is suitable for industrial purposes. The apparatus comprises a container 1 and a plunger 2, e.g. of stainless steel. The container 1 has a dished bottom wall 30, and an upstanding cylindrical side wall 31. The plunger 2 has a solid annular head 40 which surrounds a single circular opening 41 in the central. A pair of arms 42a and 42b are upstanding from the head 40 by which the head is moved axially of the container. The arms may be joined by a cross-member 42c if desired. The head 40 carries a flexible lip seal 43 which is arranged to seal against the side of the container 30 during downward movement of the plunger whilst permitting flow of liquid between the head and side wall during upward movement. The mixing action is substantially as described above. The container 30 may be jacketed and provided with a heater to

warm the contents during the mixing process. The flow of liquid down the walls of the container and the scraping action of the seal both act to improve heat transfer.

In the third form of the apparatus shown in Fig. 4 the plunger is formed integrally with the container. The apparatus is particularly suitable for kitchen use. A moulding 50 of flexible plastics such as polythene includes a cylindrical portion 58, the upper end of which may be provided with a removable closure 52. At the lower end of the cylindrical portion 51 the wall of the container extends inwardly to form an annular ring 53, below which the wall is formed into a series of corrugations 54 forming a bellows-like bottom portion 55 closed by a bottom wall 56.

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In use, the container is filled with materials to be mixed up to a level L above the ring 53. Pressing down on the top of the container causes the bellows portion 55 to collapse producing a similar radial mixing action as the contents are squeezed between the ring 53 and the bottom of the container, mixing the contents. When the container is released the bellows will expand again. If the container has a screw top or similar sealing closure it can be packed with the bellows squeezed up so that when the container is opened the bellows expand drawing air in. Packed in this state the container is particularly rigid, and any leakage in storage would cause premature expansion making the fault obvious. Such a container would be useful for mixtures that tend to separate in storage allowing the user to easily remix the contents. They could also be sold prepacked with one component of a mix so that when they are opened and the second component added they can be easily mixed together. Both components could be packaged separately one on top of the other ready for mixing, for example milk shakes.

The action of opening the container could also be used to release one component into the other, for example the powder added to milk to produce rapid setting puddings. Another possibility is to supply one component (e.g. paint colourant) in the bellows portion 55 with a peel-off seal across the top of the ring 53. The second component (e.g. a paint base ) could be sealed in a bag, which can for example be supplied in the top section.

In each of the forms of apparatus described above it will be appreciated that because the mixing action is generated below the surface of the liquid and can be controlled to limit the disturbance of the surface of the liquid, it is possible to mix with very little air entrainment. When using a bag with the apparatus of Fig.s 1 and 2, or when using the apparatus of Fig. 4, no part of the apparatus breaks the surface of the liquid. With the apparatus of Fig. 3 the means of moving the plunger can be brought in through the bottom or can run in sleeves so that nothing moves through the surface. All forms of the apparatus can thus form the basis of an excellent vacuum mixer. There is little or no entraining action and liquid is being constantly brought from the bottom of the vessel to the surface where it will be exposed to a vacuum which helps to remove any air bubbles. With a heating jacket as well as a vacuum the apparatus can form a very effective dissolver for air free solutions.

Although the container and plunger will generally be of circular section they could be of any cross-sectional shape, e.g. rectangular.

It will be appreciated that the features disclosed herein may be present in any feasible combination. Whilst the above description lays emphasis on those areas which, in combination, are believed to be new, protection is

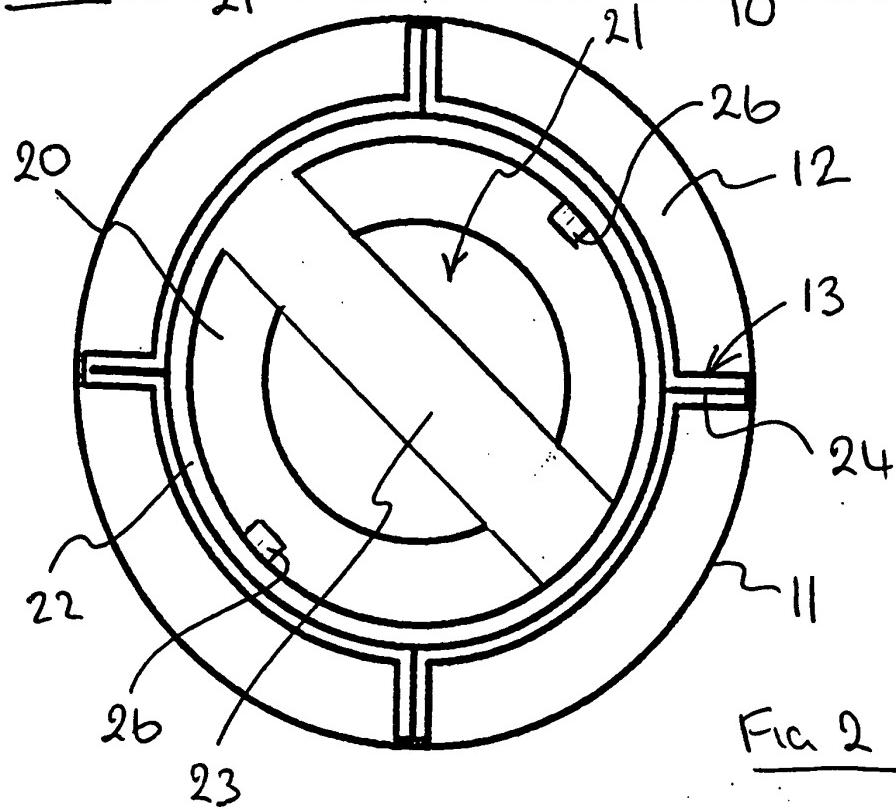
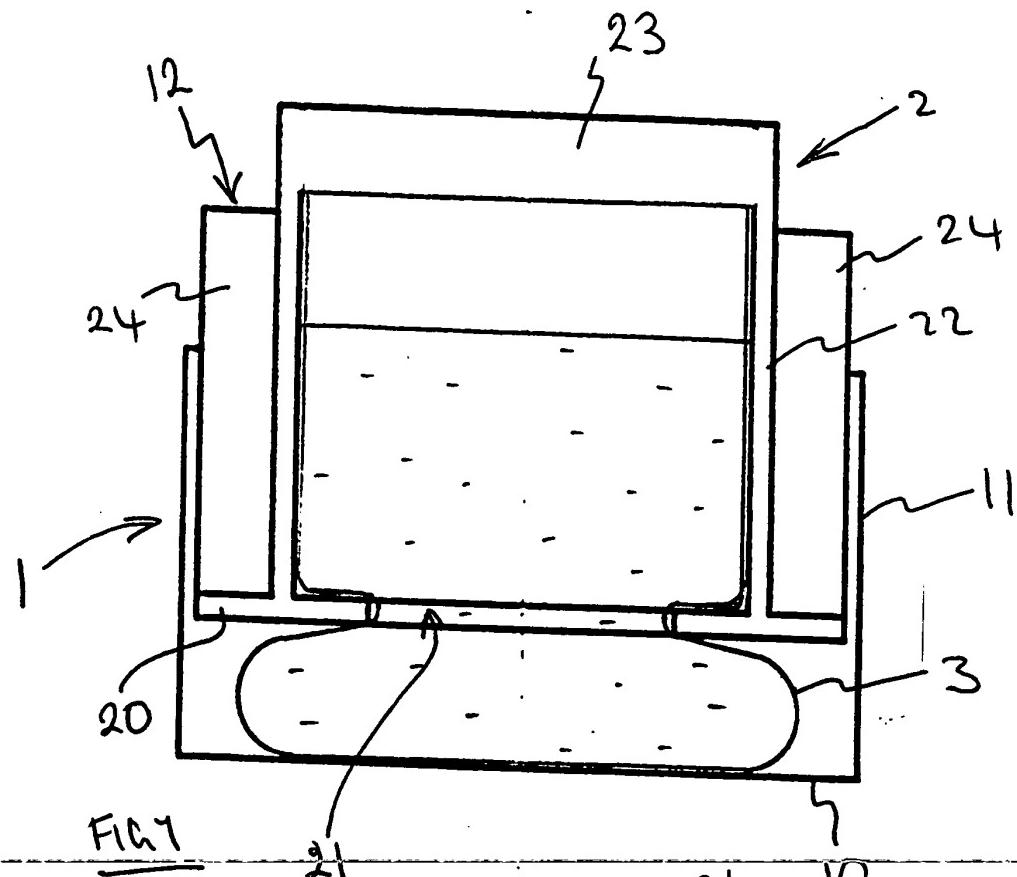
claimed for any inventive combination of the features disclosed herein.

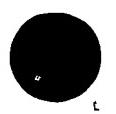
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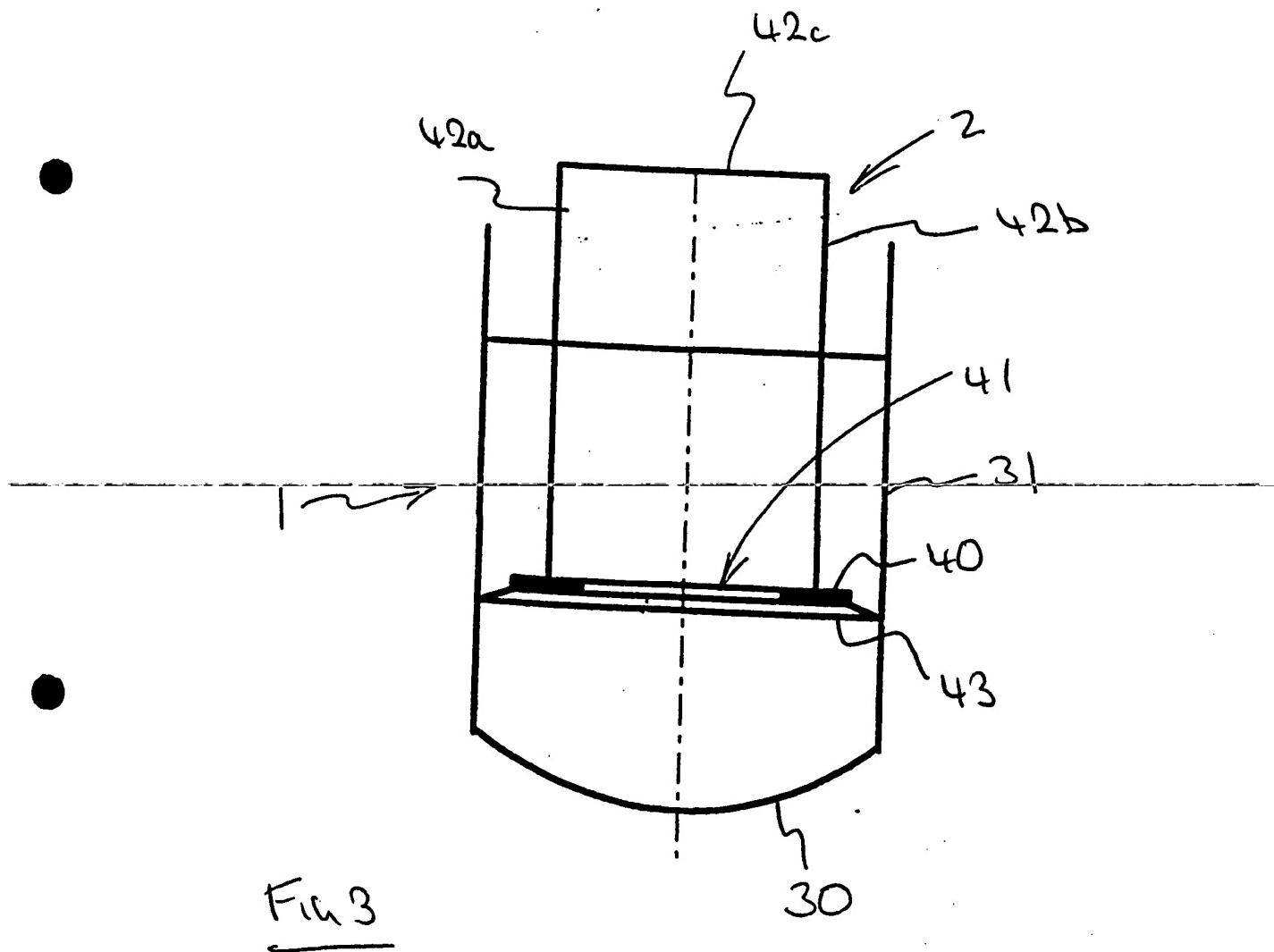
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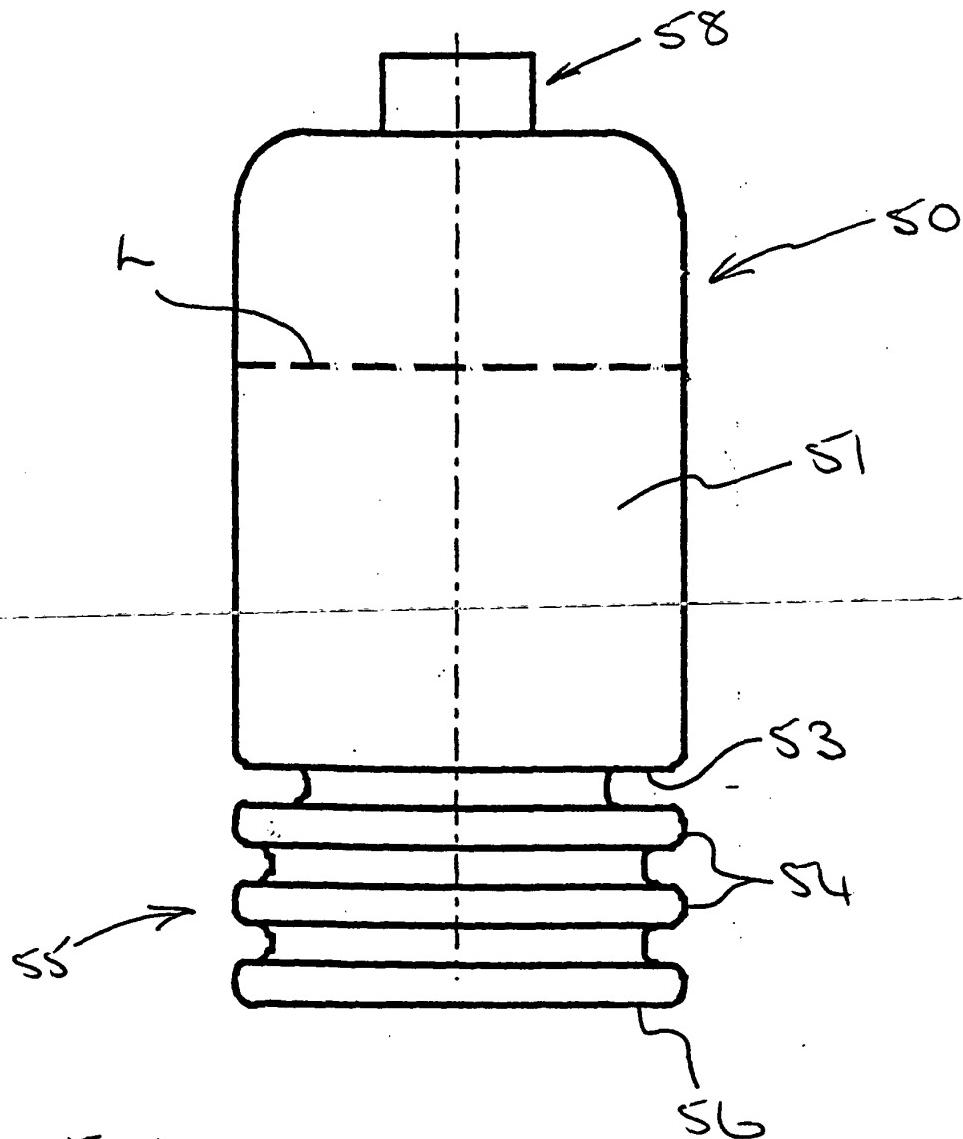


Fig 4



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